UTM
UNIVERSITI TEKNOLOGI MALAYSIA

BRIDGING EXEMPTION TEST
SEMESTER I, SESSION 2020/2021

COURSE	:	CHEMISTRY
PROGRAMME	:	BRIDGING PROGRAMME
DURATION	:	2 HOURS
DATE	:	OCTOBER 2020

INSTRUCTIONS TO CANDIDATE:

1. Do not open this question paper until you are told to do so.
2. Answer all questions.
3. All answers must be written in the answer booklet provided. Use a new page for each question.
4. All steps must be shown clearly.
5. Only non-programmable and non-graphing scientific calculators can be used.
6. You are not permitted to take the exam paper and the answer booklet(s) out of the exam hall.

WARNING!

Students caught copying/cheating during the examination will be liable for disciplinary actions and SPACE may recommend the student to be expelled from the study.

This examination question consists of (6) printed pages including this page.

QUESTION 1 (16 MARKS)

a) NaCl or sodium chloride is a metal halide composed of sodium and chloride with sodium and chloride replacement capabilities. When depleted in the human body, sodium must be replaced in order to maintain intracellular osmolarity, nerve conduction, muscle contraction and normal renal function. It is also known as an inorganic salt having Na^+ as the counter ion. NaCl appears as a white crystalline solid.
(NTP, 1992 & PubChem)

i. With respect to the Aufbau, Hund and Pauli exclusion principle, write the electron configuration and orbital diagram of atom Na and atom Cl respectively

(4 marks)

ii. Based on the electronegativity of Na (0.93) and Cl (3.16) atom :
   1) Describe the polarity of the NaCl compound using the trend in periodic table
   2) Suggest why NaCl is not a covalent bonding molecule

(2x2 marks)

iii. In a biochemical assay, a chemist needs to add 3.81 g of NaCl to a reaction mixture. Calculate the volume in millilitres of a 2.53 M NaCl solution she should use for the addition. State your answer in 3 significant figures.

(3 marks)

b) An amount of 0.5438 g sample of a liquid consisting of only C, H and O was burned in pure oxygen and 1.039 g of CO_2 and 0.6369 g of H_2O were obtained. Determine the empirical formula of the compound

(5 marks)

QUESTION 2 (17 MARKS)

a) The vapor pressure of pure water is 23.76 mmHg. If 100 g of sugar is dissolved in 500 g of water at 25°C, what is the vapor pressure of the solution [FW_{sugar} = 342]

(4 marks)

b) Calculate ⊗H for the reaction: $N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2\,H_2O(l)$

Given the following data:

$2\,NH_3(g) + 3\,N_2O(g) \rightarrow 4\,N_2(g) + 3\,H_2O(l)$ $\Delta H = -1010$ kJ

$N_2O(g) + 3\,H_2(g) \rightarrow N_2H_4(l) + H_2O(l)$ $\Delta H = -317$ kJ

$2\,NH_3(g) + \frac{1}{2}\,O_2(g) \rightarrow N_2H_4(l) + H_2O(l)$ $\Delta H = -143$ kJ

$H_2(g) + \frac{1}{2}\,O_2(g) \rightarrow H_2O(l)$ $\Delta H = -286$ kJ

(9 marks)

c) The smog constituent of peroxyacetyl nitrate (PAN) dissociates into peroxyacetyl radicals and NO_2 (g) in a second order reaction with a half-life of 32 min. If the initial concentration of PAN in an air sample is 8.3×10^{-10} mol/L, what will be the concentration 1.50h later?

PAN → peroxyacetyl radical + NO_2

(4 marks)

QUESTION 3 (17 MARKS)

a) Answer the following questions

i. When 1.0 mol of hydrogen iodide was heated to 460 ^{o}C in a 1.0 dm^3 contained 0.78 mol of hydrogen iodide remained at equilibrium. Calculate the K_C for the following equilibrium.

(3 marks)

ii. A mixture of 1.0 mol of hydrogen and 2.0 mol of iodine, in a vessel of 1.0 dm^3 capacity, was allowed to achieve equilibrium at 460 ^{o}C. Calculate the composition of the equilibrium mixture.

$$2HI(g) \leftrightarrow H_2(g)I_2(g)$$

(6 marks)

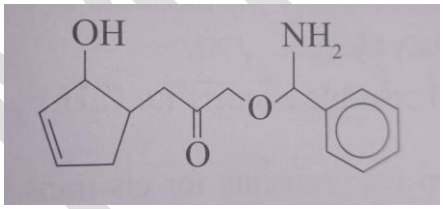
b) Boric acid dissolves in water according to the equation:

$$B(OH)_3(aq) + H_2O(aq) \leftrightarrow B(OH)_4^-(aq) + H^+(aq)$$

Explain this reaction in terms of Lewis's theory of acid/base

(2 marks)

c) Identify and name all the functional groups in the following compound



(6 marks)

LIST OF SELECTED CONSTANT VALUES

Ionisation constant for water at 25°C	K_w	=	1.00×10^{-14} mol^2 dm^{-6}
Molar volume of gases	V_m	=	22.4 dm^3 mol^{-1} at STP
			24 dm^3 mol^{-1} at RT
Speed of light in a vacuum	c	=	3.0×10^8 m s^{-1}
Avogadro's number	N_A	=	6.02×10^{23} mol^{-1}
Faraday constant	F	=	9.65×10^4 C mol^{-1}
Planck constant	h	=	6.6256×10^{-34} J s
Reduced Planck constant	$\hbar$	=	1.054×10^{-34} J s
Rydberg constant	R_H	=	1.097×10^7 m^{-1}
		=	2.18×10^{-18} J
Molar of gases constant	R	=	8.314 J K^{-1} mol^{-1}
		=	0.08206 L atm mol^{-1} K^{-1}
Boltzmann constant	k	=	1.3807×10^{-23} J K^{-1}
Mass of proton	M_p	=	1.672×10^{-27} kg
Electronic Bohr magneton	μ_B	=	9.2741×10^{-24} J T^{-1}
Nuclear Bohr magneton	β_N	=	5.05×10^{-27} J T^{-1}
Vapour pressure of water	P_{water}	=	23.8 torr
Electron charge	e^-	=	1.602×10^{-19} C

UNIT AND CONVERSION FACTOR

Energy
1 J = 1 kg m^2 s^{-2} = 1 N m = 10^7 erg
1 calorie = 4.184 Joule
1 eV = 1.602×10^{-19} J
1 amu = 1.66×10^{-27} kg

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Pressure
1 atm = 760 mm Hg = 760 torr = 101.325 kPa = 101325 N m^{-2}

SELECTED FORMULAS

$$\frac{P_1}{T_1}=\frac{P_2}{T_2} \qquad \Pi = MRT \qquad 4r = a\sqrt{2}$$

$$\frac{V_1}{n_1}=\frac{V_2}{n_2} \qquad \frac{1}{\lambda}=R\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right) \qquad rate=\sqrt{\frac{1}{density}}$$

THE PERIODIC TABLE

1 H 1.00794																	2 He 4.002602
3 Li 6.941	4 Be 9.012182											5 B 10.811	C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.9984032	10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050											13 Al 26.581538	14 Si 28.0855	15 P 30.973761	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.933200	28 Ni 58.6534	29 Cu 63.545	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.504	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 196.56655	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29
55 Cs 132.90545	56 Ba 137.327	57 La 138.9055	72 Hf 178.49	73 Ta 180.94.79	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.56655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.58038	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)		114 (289) (287)		116 (289)		118 (293)

58 Ce 140.116	59 Pr 140.50765	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.92534	66 Dy 162.50	67 Ho 164.93032	68 Er 167.26	69 Tm 168.93421	70 Yb 173.04	71 Lu 174.967
90 Th 232.0381	91 Pa 231.035888	92 U 238.0289	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)